THE WEATHER AND CIRCULATION OF SEPTEMBER 1954[1]

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PERSISTENCE OF SUMMER CIRCULATION THROUGH SEPTEMBER 1954

A conspicuous feature of the mid-tropospheric circulation for the month of September 1954 was its similarity over the Western Hemisphere to the mean circulation for the summer season of 1954. The persistence of many features of the circulation and weather during the individual months of this summer has previously been noted [1, 2]. Comparison of figures 1 and 2 shows that this summertime persistence carried on into September to a remarkable degree. Over the region from the central Pacific eastward to western Europe the troughs and ridges during September (fig. 1) were located in very nearly the same longitudinal positions as they were during the summer (fig. 2). Likewise the fields of 700-mb. height anomaly for summer and September were rather highly correlated over this area. In fact, over a limited region covering the United States and the adjacent western Atlantic,[2] the correlation coefficient between the fields of 700-mb. height anomaly for summer and September 1954 was +.52. There are no comparable coefficients available for other years, but the average one-month lag correlation for August-September for the same area during a period of 18 years was about +.30 [3]. For strict comparison the correlation coefficient for August-September 1954 was also computed and its value was +.62. Thus, it is safe to conclude that September's circulation exhibited more persistence from previous months than is usually found at this time of year. Furthermore, visual inspection of all mean 700-mb. charts for summer and September revealed that no other year in the entire period of record (back to 1933) exhibited anywhere near the degree of persistence observed this year over the Western Hemisphere. The unusually stable nature of this circulation pattern in roughly one-half of the Northern Hemisphere, while the circulation over the other half underwent relatively well-marked changes, suggests that thermodynamic factors (i. e., the effects of differential heating over continents and oceans) may play a major role in such cases of persistence.

[1] See Charts I-XV following p. 279 for analyzed climatological data for the month.

[2] Latitudes 30° to 50° N., longitudes 50° to 125° W.

CIRCULATION FEATURES OF SEPTEMBER 1954 IN RELATION TO WEATHER OVER THE UNITED STATES

The circulation feature most directly associated with United States weather during September 1954 was the zonally-oriented continental ridge which covered the southern two-thirds of the United States (fig. 1). Under this broad mean ridge, in which height anomalies were all positive, above-normal surface temperatures prevailed (Chart I-B). Note that a pronounced belt of temperatures in excess of 4° F. above normal roughly paralleled the axis of maximum positive height anomaly at 700 mb. (fig. 1). In this zone during the first week of the month some unusually high daily temperature readings for September were registered. For instance, it was 103° F. at Kansas City, Mo. on the 2d; 105° F. at Fort Smith, Ark. on the 3d; 104° F. at St. Louis, Mo. on the 4th; 105° F. at Nashville, Tenn. on the 5th; 105° F. at Shelbyville, Ky. on the 6th, and 103° F. at Richmond, Va. on the 7th.

As is usually the case in the warmer season over the United States, hot weather was accompanied by little rainfall over much of the area dominated by the continental anticyclone aloft (Chart III). Note that the southern half of the country under this ridge was free of cyclones (Chart X) and had comparatively few fronts (fig. 3). As a result, rather severe drought conditions persisted through September over much of Texas, Oklahoma, the Carolinas, Georgia, and Alabama. These States were comparatively dry throughout the entire summer (cf. fig. 1B of [2]) and have been generally deficient in precipitation for the past few years.

Significant breaks in the drought situation occurred this month in large portions of Louisiana, Mississippi, Tennessee, and Kentucky (Chart III). Heavier-than-normal rainfall in the first two of these States was related to the development of a mean easterly wave at 700 mb. in the northern Gulf of Mexico where easterly flow was stronger than normal (fig. 1). As is typical of easterly waves on daily or shorter-period charts, precipitation occurred on the east side of the trough line. Heavier-than-normal precipitation over Kentucky and Tennessee showed little relation to the mean circulation. Most of

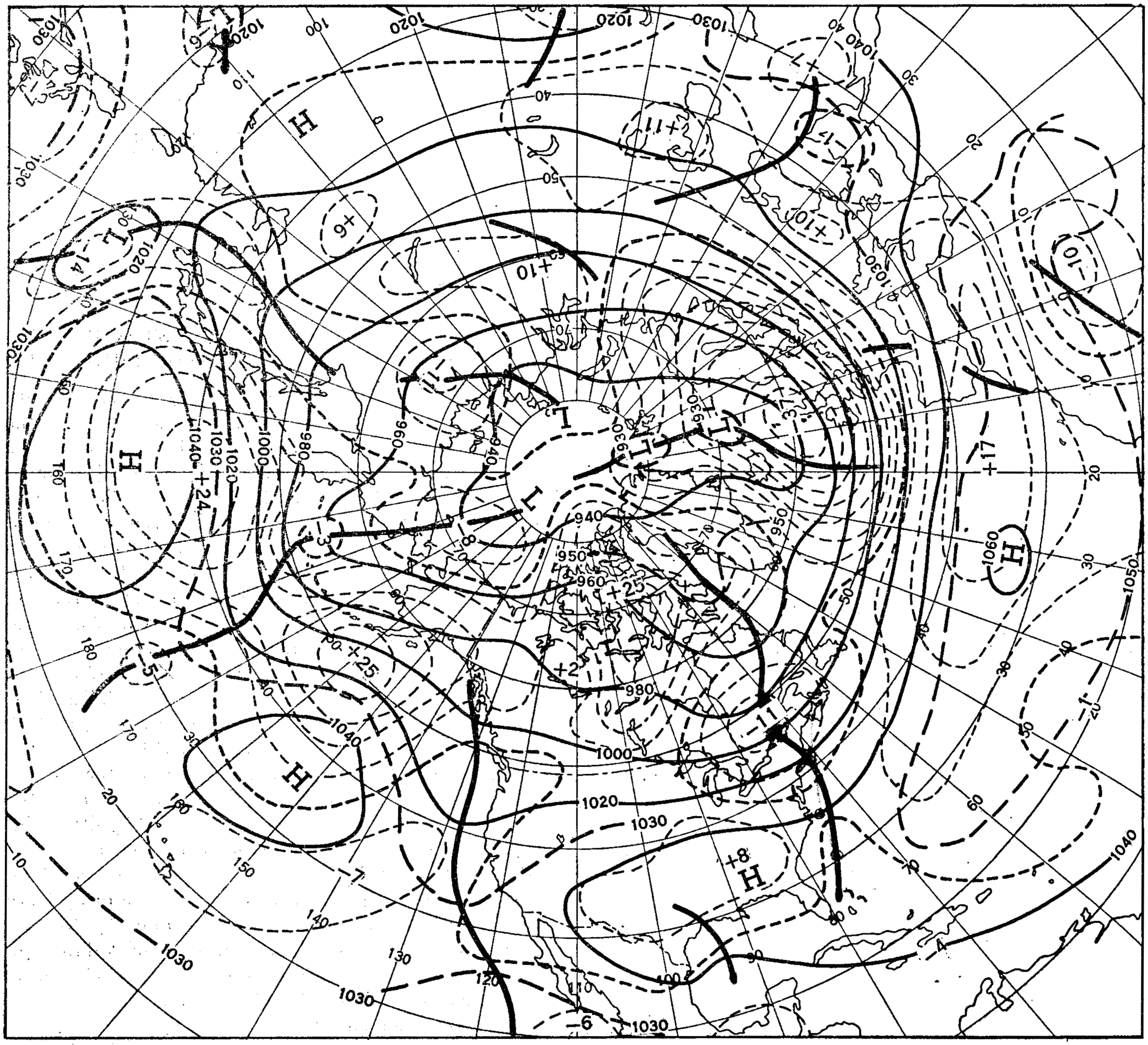


FIGURE 1.—Mean 700-mb. contours and height departures from normal (both in tens of feet) for August 31–September 29, 1954. Wave pattern over Western Hemisphere was very similar to prevailing pattern of summer of 1954 (fig. 2). For United States area major circulation feature was extensive anticyclonic circulation in southern portion.

this substantial precipitation occurred within a few days around the 20th when the passage of a well-defined daily trough and accompanying cold front and squall lines brought heavy showers to the area.

In Arizona, Utah, eastern Nevada, and northwestern Colorado precipitation was also in excess of normal (Chart III). This was associated with moisture transported from the Gulf of Mexico around the southwestern and western peripheries of the mean continental ridge (fig. 1). Inspection of daily and 5-day mean 700-mb. charts indicates that much of this precipitation occurred when a trough or Low center moved into the area from the prevailing trough off the west coast, thereby providing a mechanism for widespread shower activity. These troughs also brought several thrusts of cool Pacific air into the Far West so that surface temperatures over that area were generally somewhat below normal (Chart I-B).

The mean trough in eastern North America (fig. 1) had some important direct influence on the weather over the Northeast and along much of the immediate Atlantic coastal strip during September. Since the trough was deeper than normal mainly in its middle-latitude section, surface temperatures in the East were cooler than normal only in New England, New York, and northern New

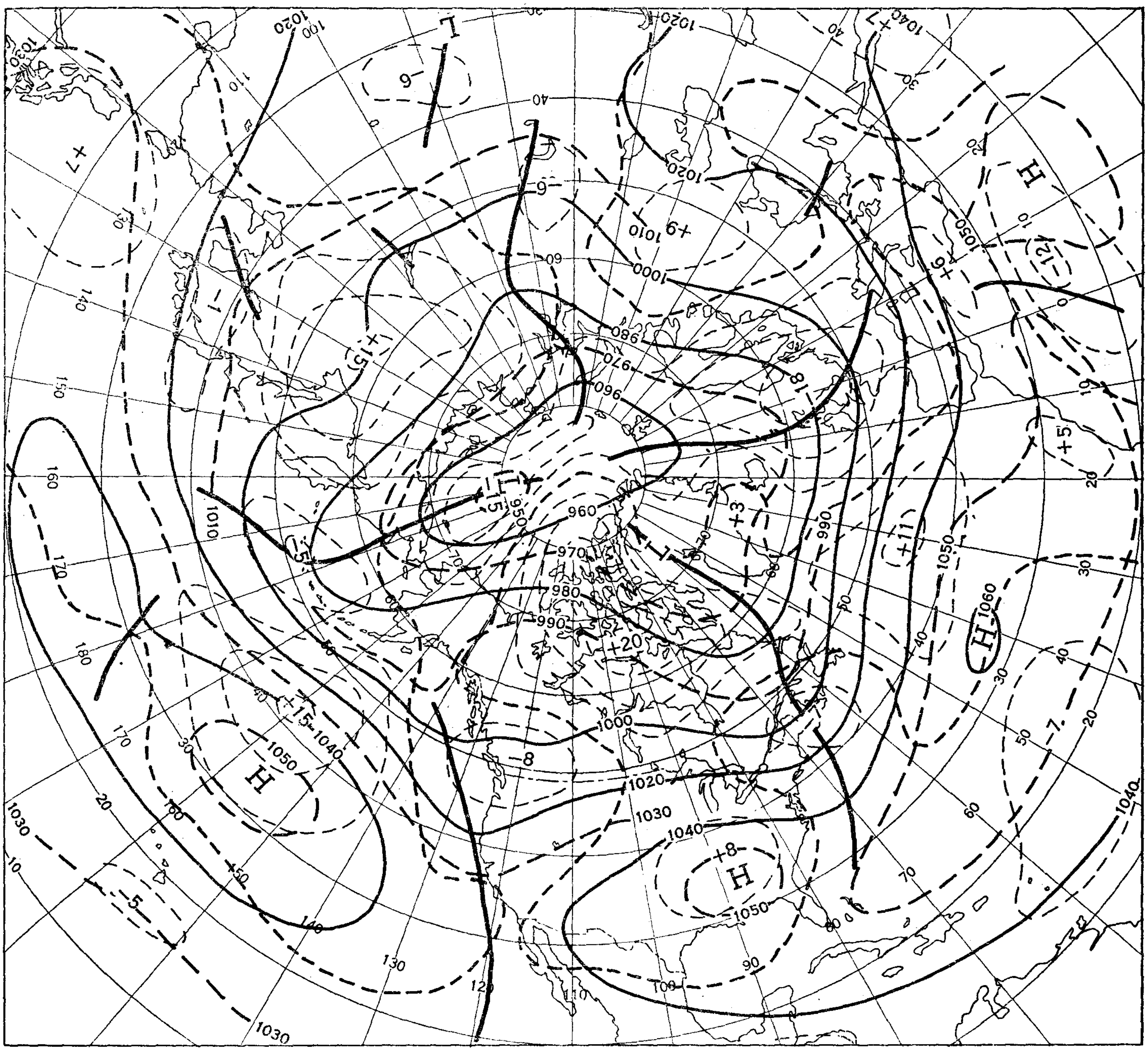


FIGURE 2.—Mean 700-mb. contours and height departures from normal (both in tens of feet) for summer 1954. Month-to-month persistence of many circulation features during the season makes this chart very representative of the prevailing circulation of the summer. Comparison with figure 1 indicates that persistence continued through September over the Western Hemisphere.

Jersey (Chart I-B), where heights aloft were below normal. Farther south stronger-than-normal westerly flow and the proximity of the continental anticyclone aloft allowed warm weather to dominate the coastal region.

Precipitation over New England and the Atlantic coastal strip was heavier than normal for September largely as a result of the rainfall associated with hurricane Edna which moved north-northeastward close to the coast on the 10th and 11th (Chart X). The path of this storm between the Bahamas and New England lay within a few degrees of latitude of the position of the monthly mean trough (fig. 1). This storm's pronounced meridional motion was associated with a marked increase in amplitude of the long-wave trough along the east coast as the cyclone came out of the subtropics. Its large-scale evolution in this sense was somewhat akin to that of the hurricane of September 1938 [4] and of hurricane Carol which battered the New England coast on the last day of August 1954 [2]. Details of the case history of Edna are given in an article in this issue by Malkin and Holzworth [5].

A combination of heavier-than-normal precipitation and mostly below normal temperatures characterized the weather regime along the northern border sections of the country this month (Charts I-B and III). South of this zone very strong gradients of surface temperature and precipitation were located, indicating the presence of a strong mean polar front boundary stretching zonally across the United States. This frontal concentration over the northern United States is clearly illustrated in figure 3. Note how closely the boundary lines between positive and negative temperature and precipitation anomalies coincided with the axis of maximum frontal frequency across the country from Montana eastward.

East of the Rockies the axes of the monthly mean wind maxima at both 700 mb. (fig. 4A) and 200 mb. (fig. 5) were located directly above this maximum concentration of fronts and the accompanying contrast zone between temperature and precipitation. During August, however, this coincidence of jet axes and frontal concentration was not nearly so close. The maximum wind speed axes at both 700 mb. and 200 mb. (cf. figs. 3A and 4 of [2]) were located at nearly the same latitude across the United States as in September, but the maximum frontal concentration and boundary zones of surface temperature and precipitation (cf. fig. 6 and Charts I-B and III of [2]) were roughly 5° of latitude farther south. The southward displacement of the polar fronts last month was attributed to the great intensity of the blocking conditions over northern Canada. Blocking persisted in this area during September (fig. 1), but was considerably weaker than in August (cf. fig. 2 of [2]). As a result anticyclones moved in a more zonal fashion in September (Chart IX) and Canadian Highs generally did not penetrate as far southward as they did in August (cf. Chart IX and fig. 5B of [2]), when meridional motions of the Highs were predominant.

The relaxation of blocking conditions over Canada was also reflected in the more frequent number of cyclones passing through the northern United States and southern Canada during September (Chart X). Most of these storms traveled on the north side of the monthly mean jet stream (figs. 4A and 5) where wind speeds were somewhat weaker than normal (fig. 4B).

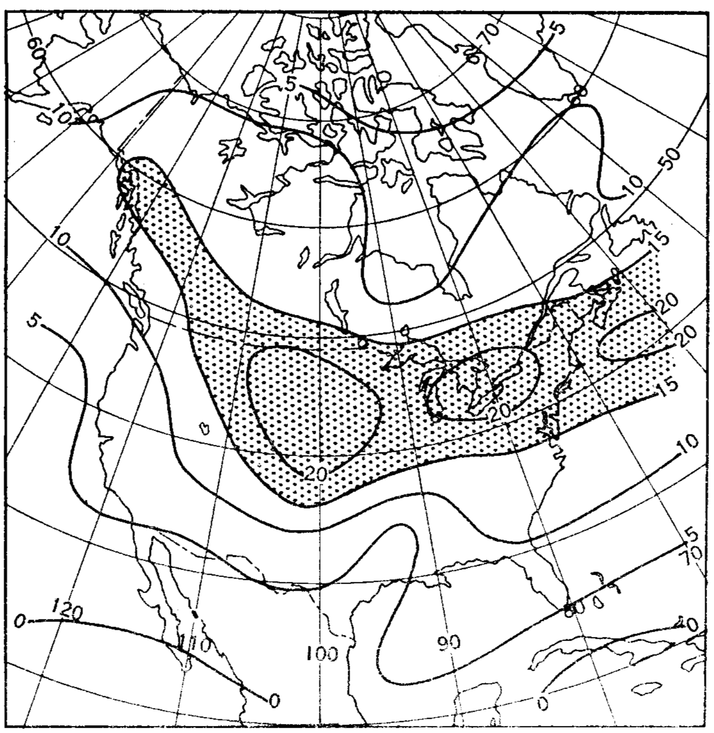


FIGURE 3.—Number of days in September 1954 with surface fronts of any type (within squares with sides approximately 500 miles). Frontal positions taken from *Daily Weather Map*, 1:30 p. m. EST. Sharp contrasts in temperature and precipitation regimes (see Charts I-B and III) existed across the zonal axis of maximum frontal frequency in northern portion of the United States. Fronts were less frequent in southern United States which was dominated by the continental ridge aloft (fig. 1).

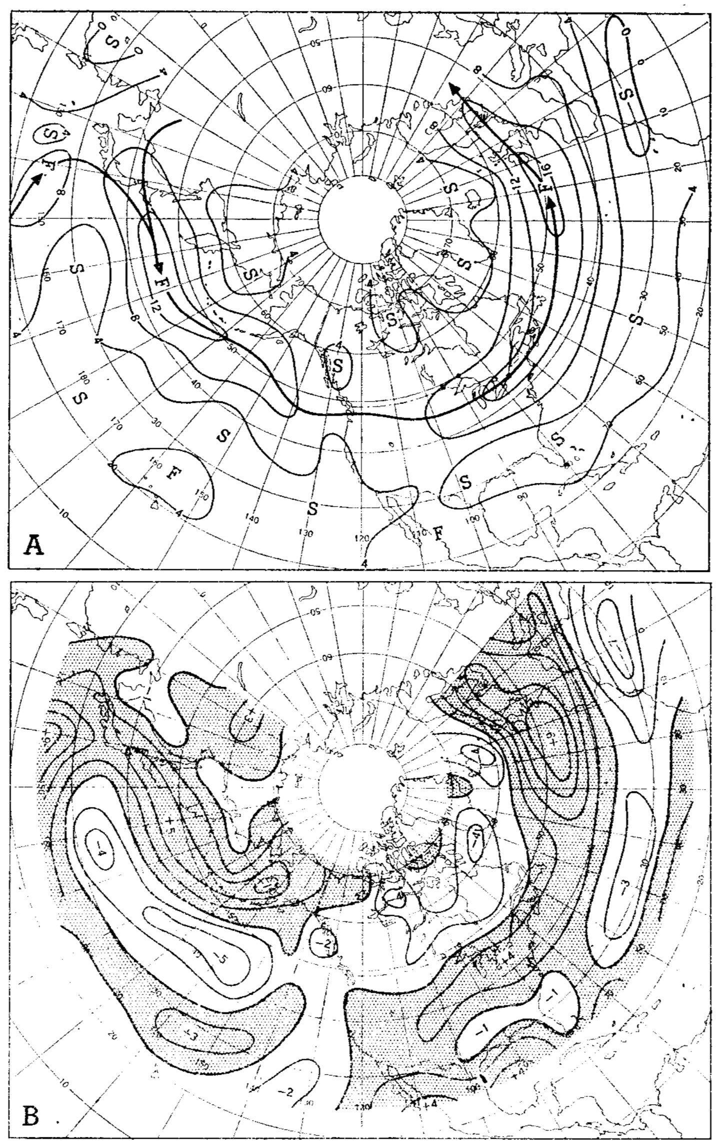


FIGURE 4.—(A) Mean 700-mb. isotachs and (B) departure from normal wind speed (both in meters per second) for August 31–September 29, 1954. Solid arrows indicate major axes of maximum flow. Axis of maximum flow across North America extended zonally through northern United States nearly coinciding with axis of maximum frontal frequency shown in figure 3. Strongest flow on map was located in eastern Atlantic where mean winds of 16 m/sec were 9 m/sec above normal.

OUTSTANDING CIRCULATION FEATURES IN OTHER PARTS OF THE NORTHERN HEMISPHERE

Over the British Isles and adjacent sections of Europe 700-mb. height anomalies were negative once again in September (fig. 1) as they have been during the entire summer (fig. 2). However, the negative anomaly center was stronger than it had been in any of the summer months and was almost 10° of latitude farther north than its position in August (cf. fig. 2 of [2]). Meanwhile heights were well above normal in the Azores High and over the Mediterranean. Thus, westerly flow at middle latitudes over the eastern Atlantic and western Europe was as much as 9 m/sec stronger than normal (fig. 4B). At 700 mb. the strongest winds in the Northern Hemisphere were located near latitude 50° and longitude 20° W. (fig. 4A). The axis of this pronounced jet stream at both 700 mb. and 200 mb. crossed southern Britain and the North Sea (figs. 4A and 5). As a result, the weather in the British Isles and adjacent areas of northwestern Europe during September was cool with frequent storminess and many frontal passages. Since the westerlies were so strong, eastern sections of England and Scotland had subnormal rainfall while western sections continued to experience heavier-than-normal amounts. This regime extended for yet another month the very long spell of cyclonic weather over this region which had set in as early as May.

The Japanese Islands experienced during September 1954 some of the most severe and frequent typhoon activity in recent history. The tracks of the typhoons in the western Pacific during September are indicated in figure 6 superimposed on the mean 700-mb. flow for September (same as fig. 1). Note that three storms (I, J, and M) traversed the southwestern portion of the Islands (Kyushu and/or southern Honshu). One of these (J) moved due northward into Manchuria, while the other two moved northeastward through the Sea of Japan, finally approaching or crossing the northern island of Hokkaido. A fourth storm (K) brushed by the southeastern coast of Honshu as it moved northeastward toward middle latitudes of the Pacific. These storms were unusual not only in their frequency and severity, but also in that their paths were more meridional than normal.

Probably of major importance in determining the paths of these September typhoons was the large mean subtropical High at 700 mb. over the western Pacific. Heights in this anticyclone and its associated ridge were considerably above normal from the subtropics well northward through the middle-latitude westerlies (fig. 1). These positive anomalies, as well as the anticyclonic curvature of the mean 700-mb. contours, extended westward to the Japanese Islands. The subtropical and middle-latitude trough to the west of this ridge was also more intense than normal with a rather deep Low center near latitude 25° N. This trough, which was mainly a reflection of the typhoons, was a relatively shallow system and did not show up in the mean at 200 mb., whereas the anticyclonic circulation dominated the subtropical western Pacific at 200 mb. even more than it did at 700 mb. (fig. 5).

The height anomalies at 700 mb. in the western Pacific were associated with abnormally strong geostrophic flow out of tropical regions toward Japan and middle latitudes (fig. 4). It is of interest to note that by and large the typhoons traveled on the west side of the axis of maximum flow shown in figure 4A and to the east of the mean trough with its axis of negative height anomaly (fig. 1). The tendency for tropical cyclones to travel northward toward middle latitudes in the vicinity of pronounced mean troughs in the westerlies has been observed frequently. The tendency for tropical storm tracks to be located in the cyclonic shear zone on the left side of the axis of the

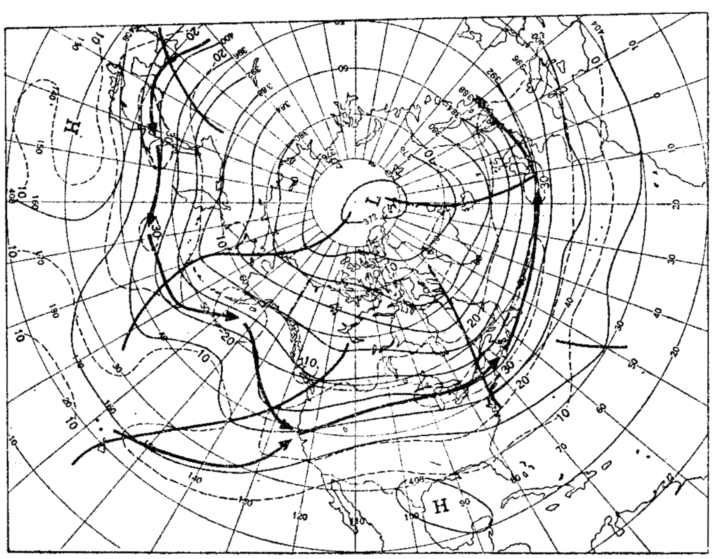


FIGURE 5.—Mean 200-mb. contours (in hundreds of feet) and isotachs (dashed, in meters per second) for August 31–September 29, 1954. Solid arrows indicate the axes of monthly mean jet streams. Circulation pattern and jet axes are very similar to 700-mb. features of figures 1 and 4A, except over eastern Pacific.

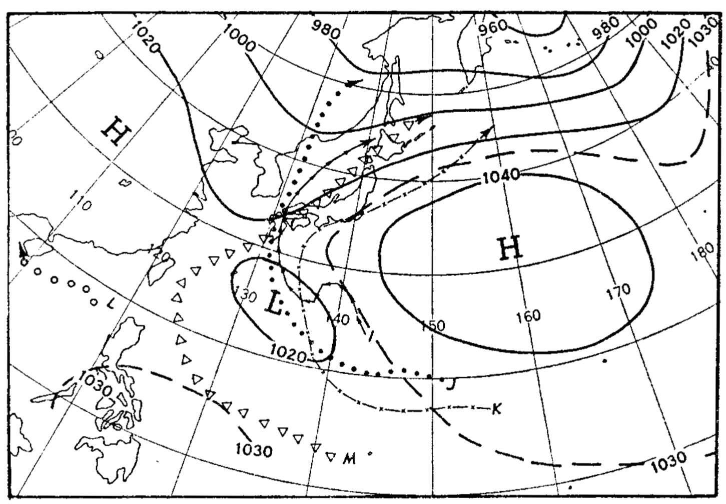


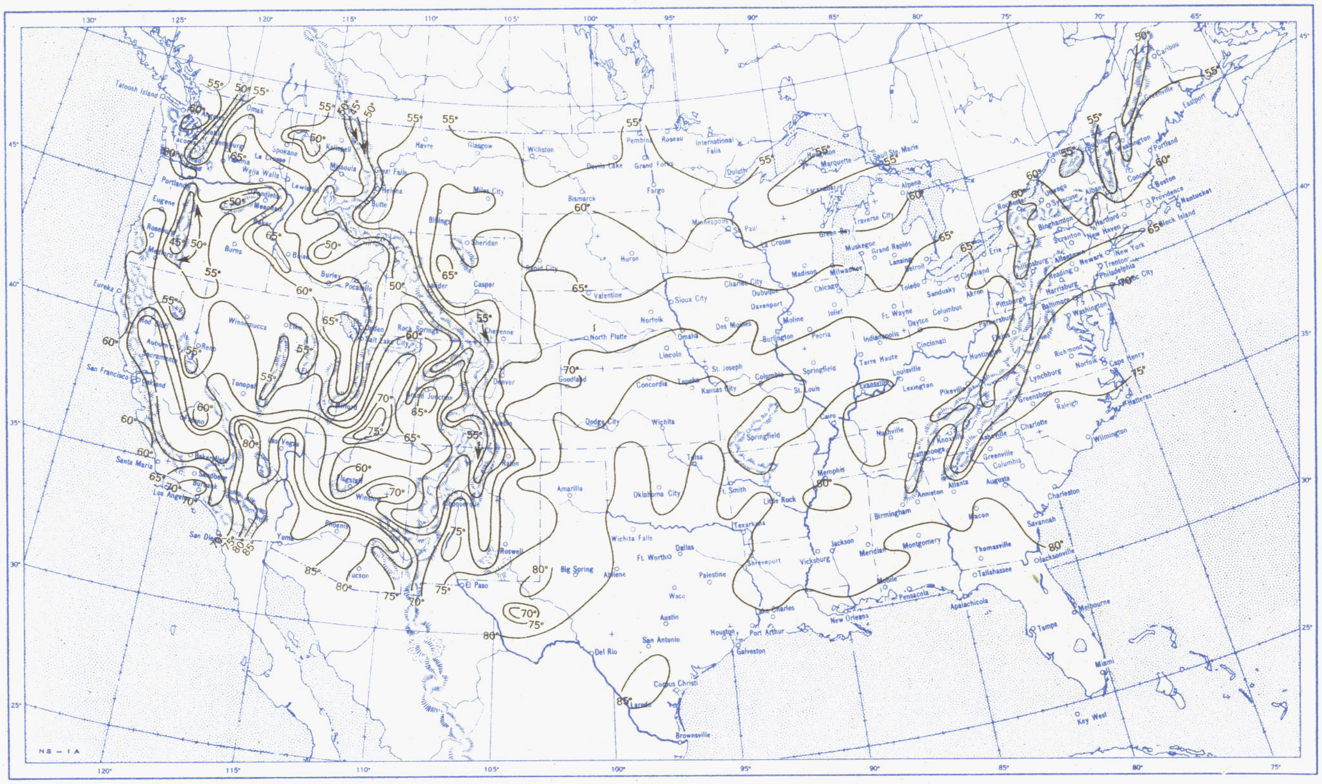
FIGURE 6.—Tracks of typhoons in western Pacific during September 1954 superimposed on mean 700-mb. contours (same as in fig. 1). Letters at beginnings of tracks are first letters of officially designated names of Pacific typhoons. Alphabetical order represents chronology of typhoon occurrence. Four of the five typhoons affected the Japanese Islands, taking a large toll of lives and property. Unusual frequency of typhoon tracks in far westerly position over Japan was associated with abnormally strong upper anticyclone in western Pacific. (See anomalies of 700-mb. height in fig. 1.)

mean current at 700 mb. is not so well established, but it has been frequently noted in this series of articles that major extratropical storm tracks are often so located with respect to mean westerly jet streams.

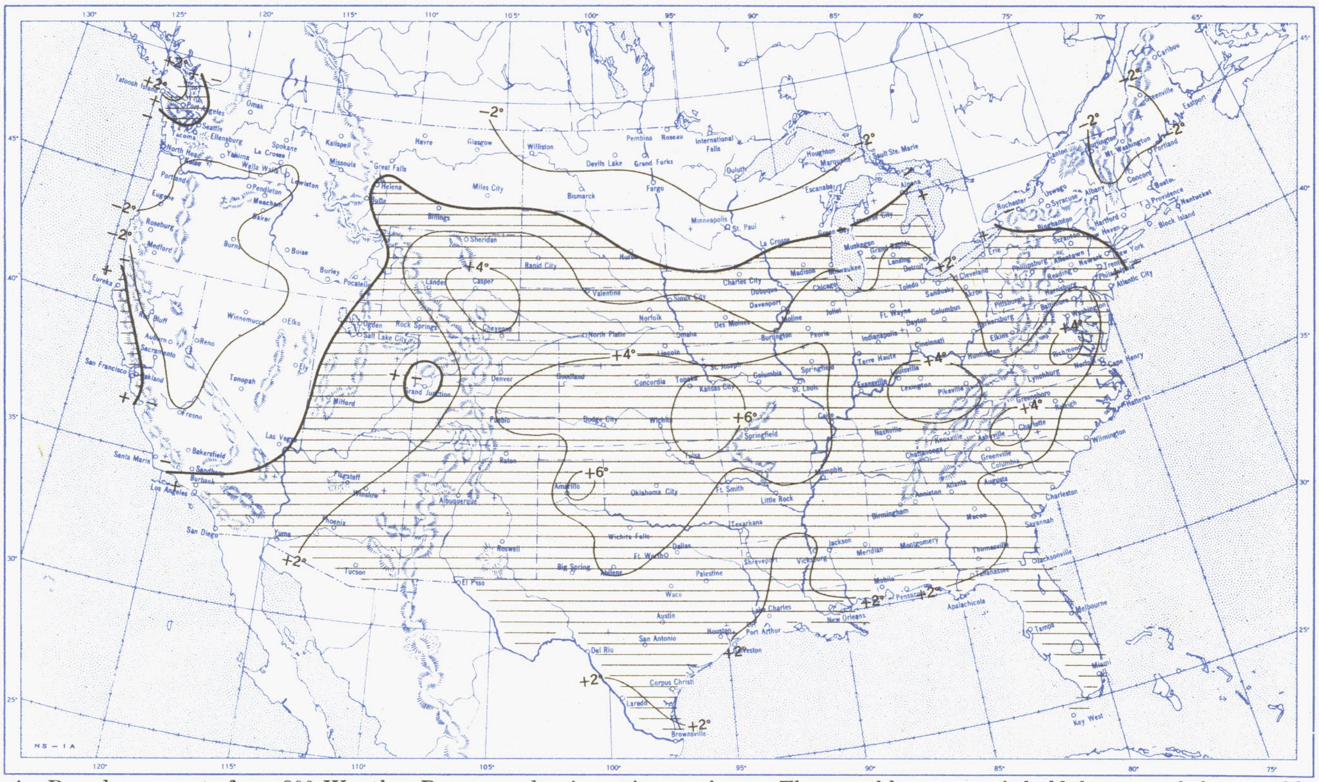
REFERENCES

1. H. F. Hawkins, Jr., "The Weather and Circulation of July 1954—One of the Hottest Months on Record in the Central United States," *Monthly Weather Review*, vol. 82, No. 7, July 1954, pp. 209–217.
2. J. S. Winston, "The Weather and Circulation of August 1954—Including a Discussion of Hurricane Carol in Relation to the Planetary Wave Pattern," *Monthly Weather Review*, vol. 82, No. 8, Aug. 1954, pp. 228–236.
3. J. Namias, "The Annual Course of Month-to-Month Persistence in Climatic Anomalies," *Bulletin of the American Meteorological Society*, vol. 33, No. 7, Sept. 1952, pp. 279–285.
4. C. H. Pierce, "The Meteorological History of the New England Hurricane of Sept. 21, 1938," *Monthly Weather Review*, vol. 67, No. 8, Aug. 1939, pp. 237–285.
5. W. Malkin and G. C. Holzworth, "Hurricane Edna, 1954," *Monthly Weather Review*, vol. 82, No. 9, Sept. 1954, pp. 267–279.

Chart I. A. Average Temperature (°F.) at Surface, September 1954.

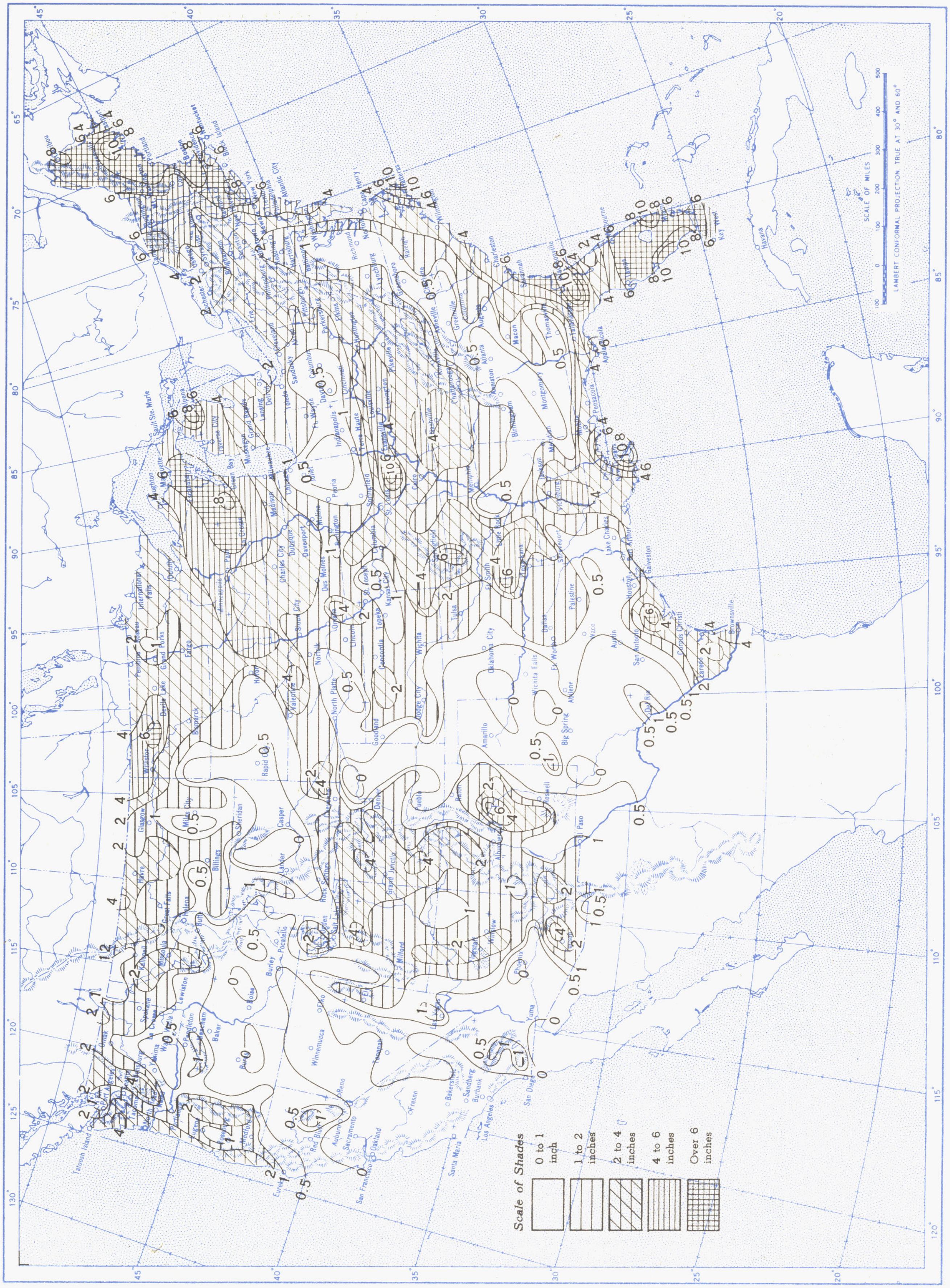


B. Departure of Average Temperature from Normal (°F.), September 1954.



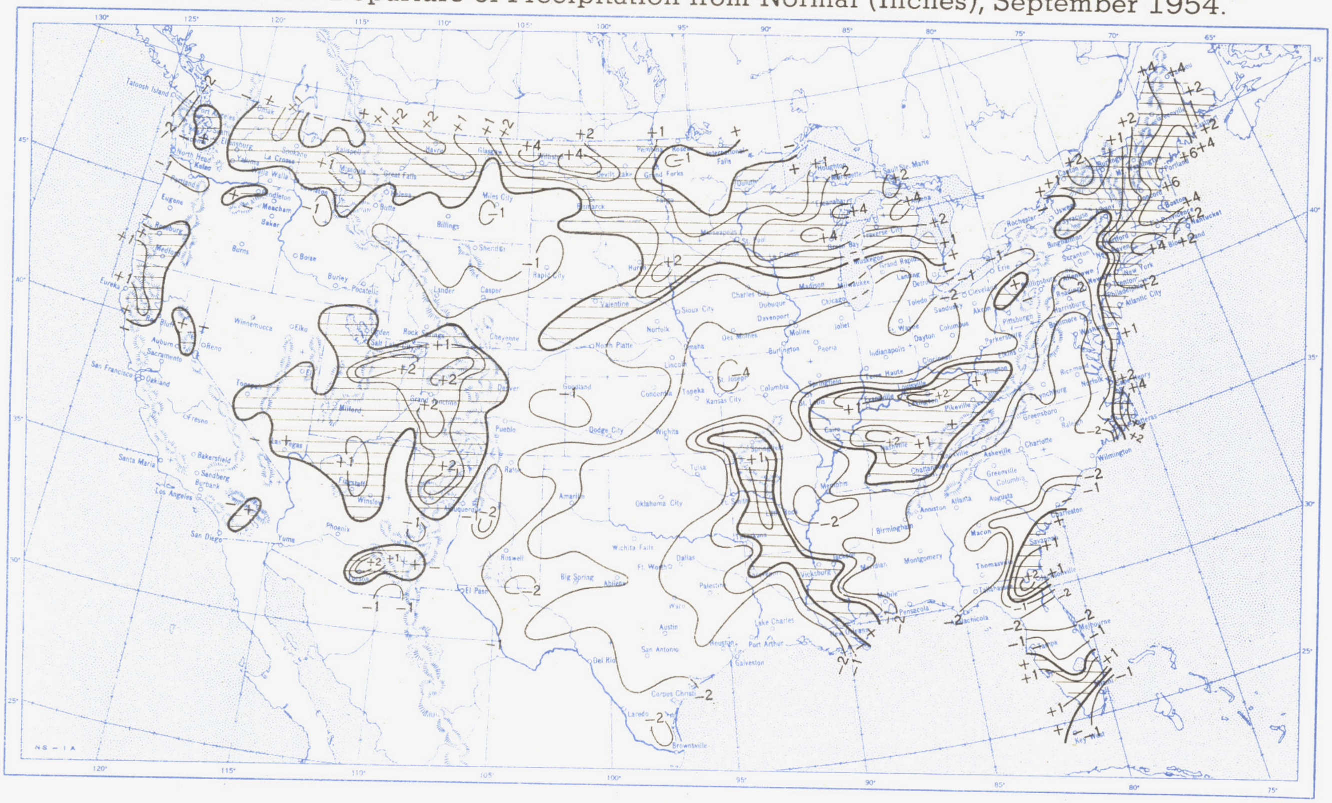
A. Based on reports from 800 Weather Bureau and coöperative stations. The monthly average is half the sum of the monthly average maximum and monthly average minimum, which are the average of the daily maxima and daily minima, respectively.
B. Normal average monthly temperatures are computed for Weather Bureau stations having at least 10 years of record.

Chart II. Total Precipitation (Inches), September 1954.

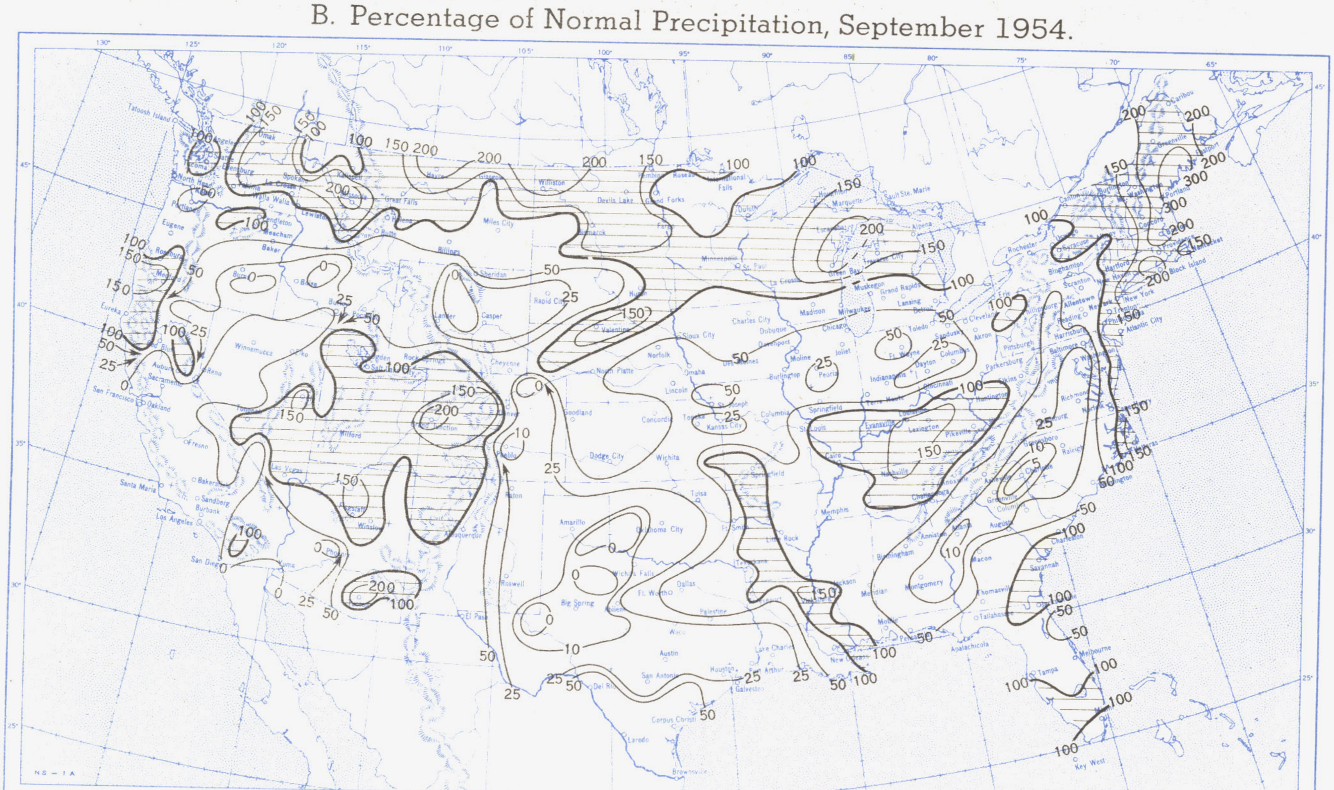


Based on daily precipitation records at 800 Weather Bureau and cooperative stations.

Chart III. A. Departure of Precipitation from Normal (Inches), September 1954.

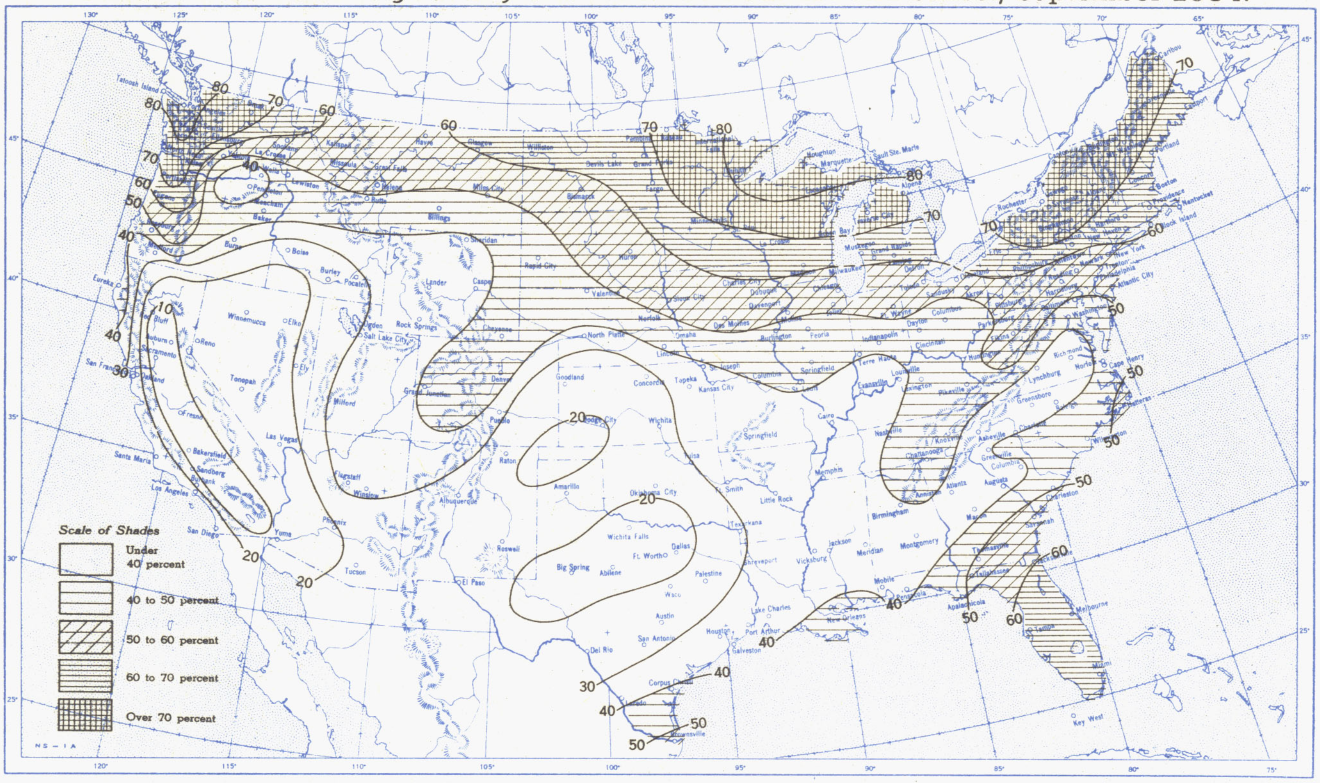


B. Percentage of Normal Precipitation, September 1954.

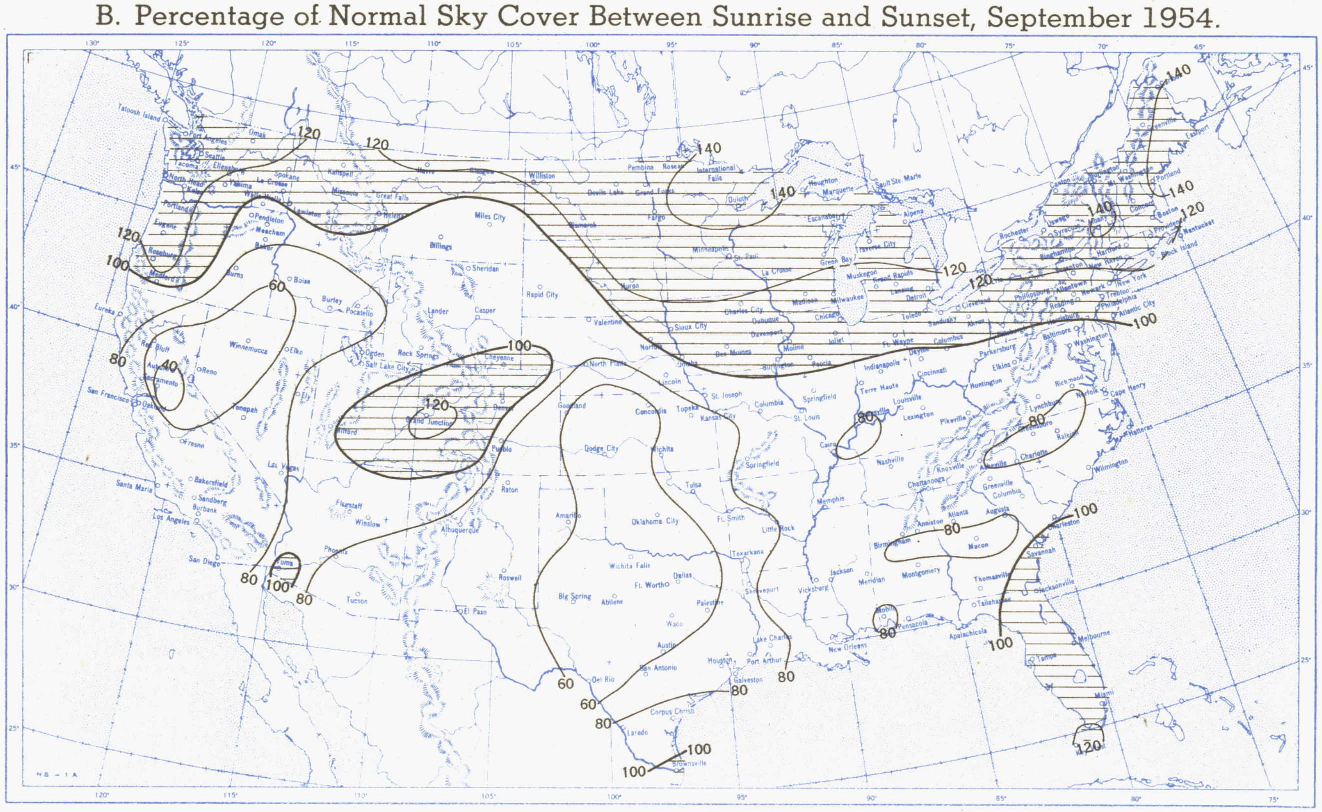


Normal monthly precipitation amounts are computed for stations having at least 10 years of record.

Chart VI. A. Percentage of Sky Cover Between Sunrise and Sunset, September 1954.

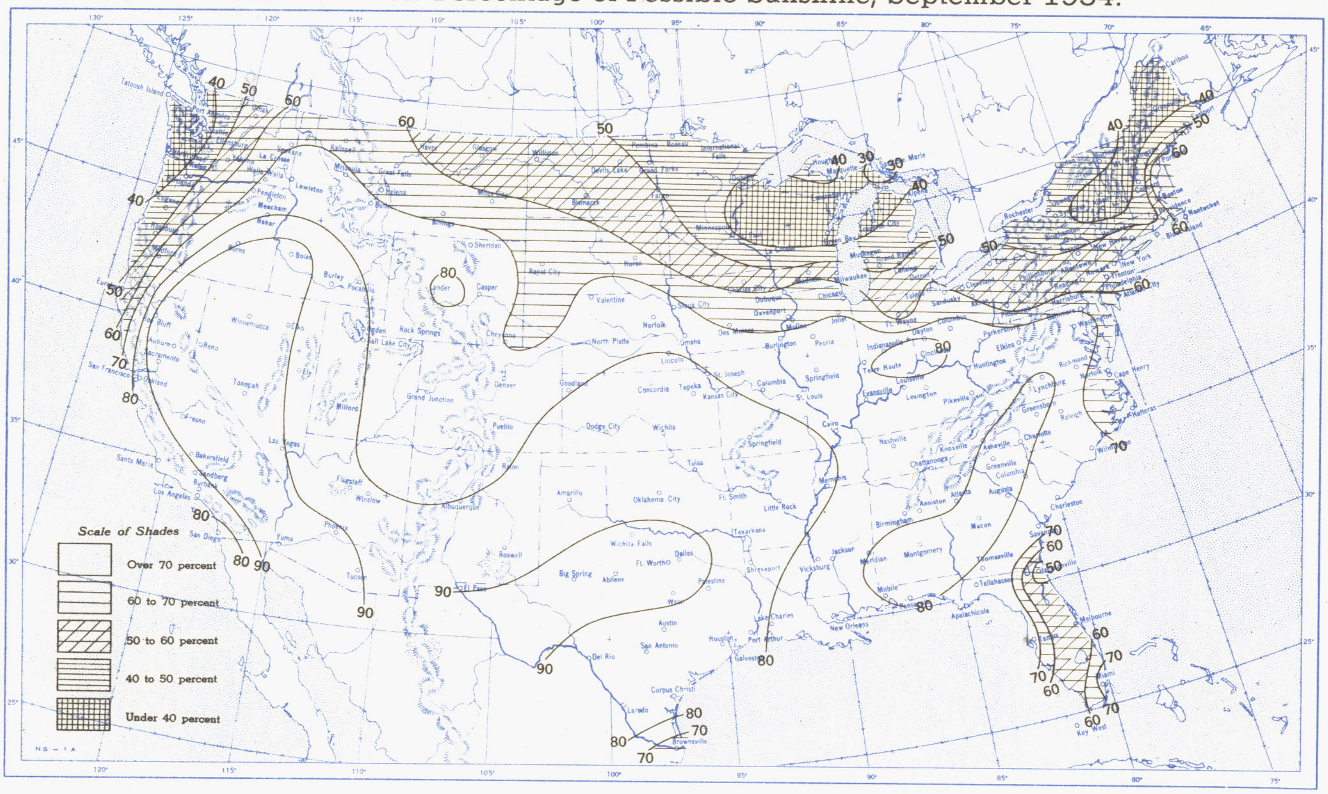


B. Percentage of Normal Sky Cover Between Sunrise and Sunset, September 1954.

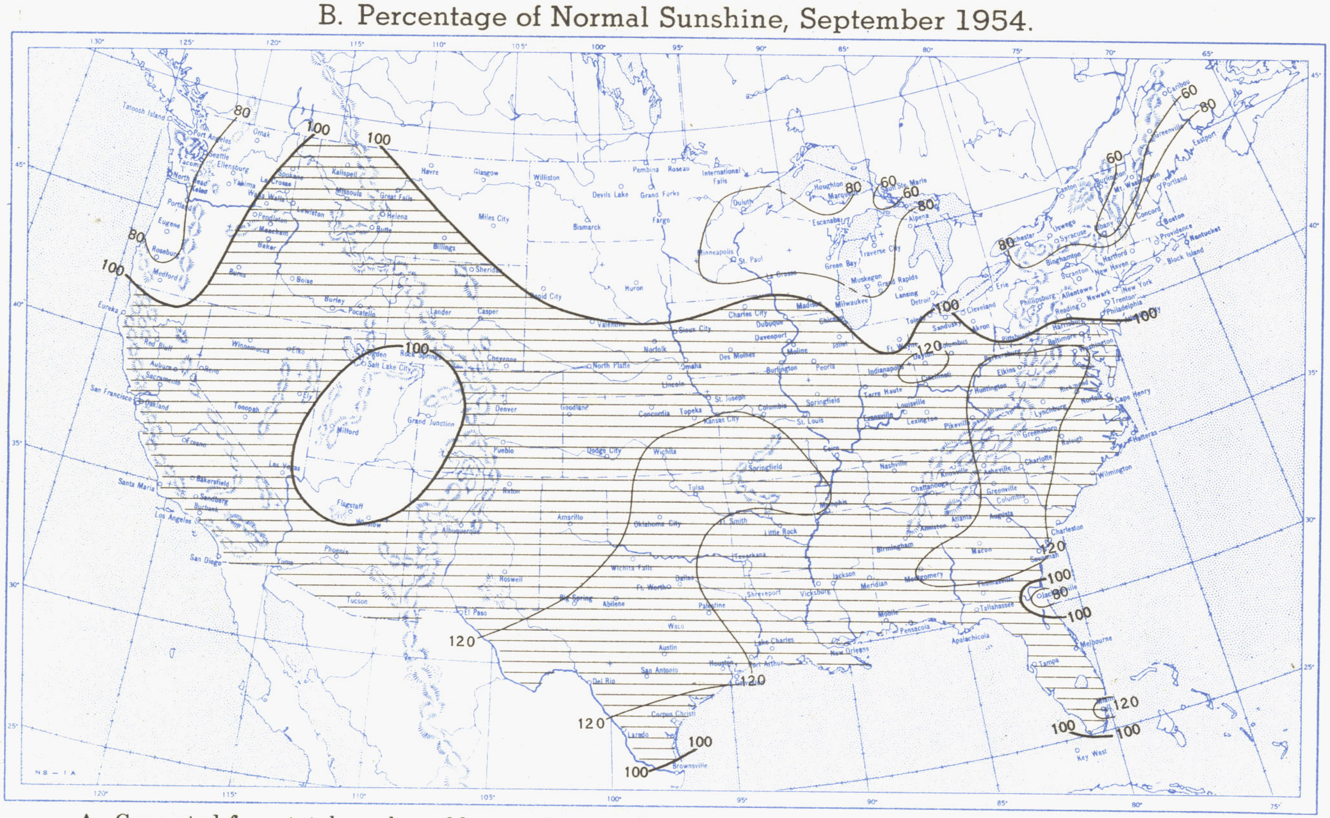


A. In addition to cloudiness, sky cover includes obscuration of the sky by fog, smoke, snow, etc. Chart based on visual observations made hourly at Weather Bureau stations and averaged over the month. B. Computations of normal amount of sky cover are made for stations having at least 10 years of record.

Chart VII. A. Percentage of Possible Sunshine, September 1954.



B. Percentage of Normal Sunshine, September 1954.



A. Computed from total number of hours of observed sunshine in relation to total number of possible hours of sunshine during month. B. Normals are computed for stations having at least 10 years of record.

Chart VIII. Average Daily Values of Solar Radiation, Direct + Diffuse, September 1954. Inset: Percentage of Normal Average Daily Solar Radiation, September 1954.

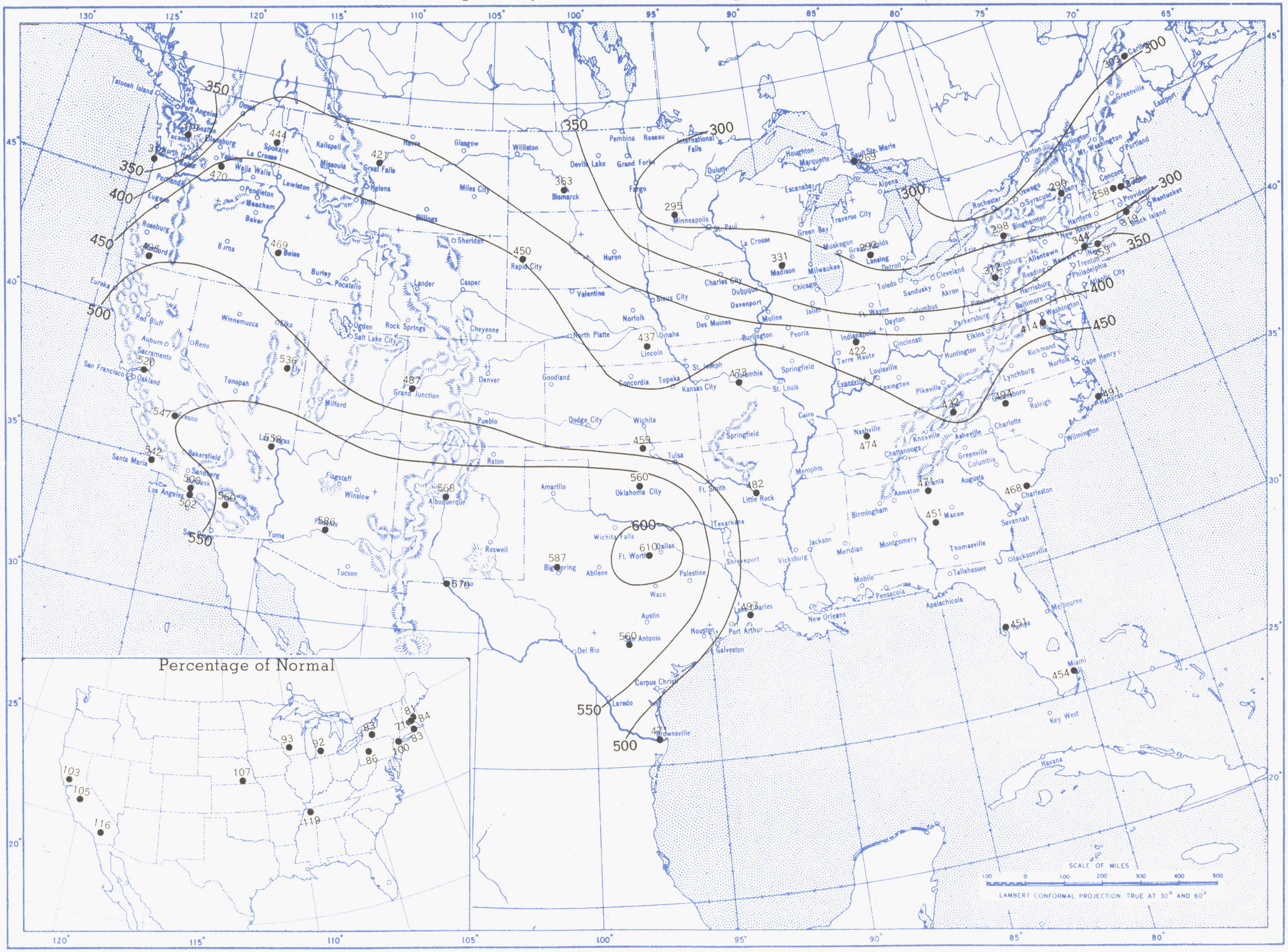
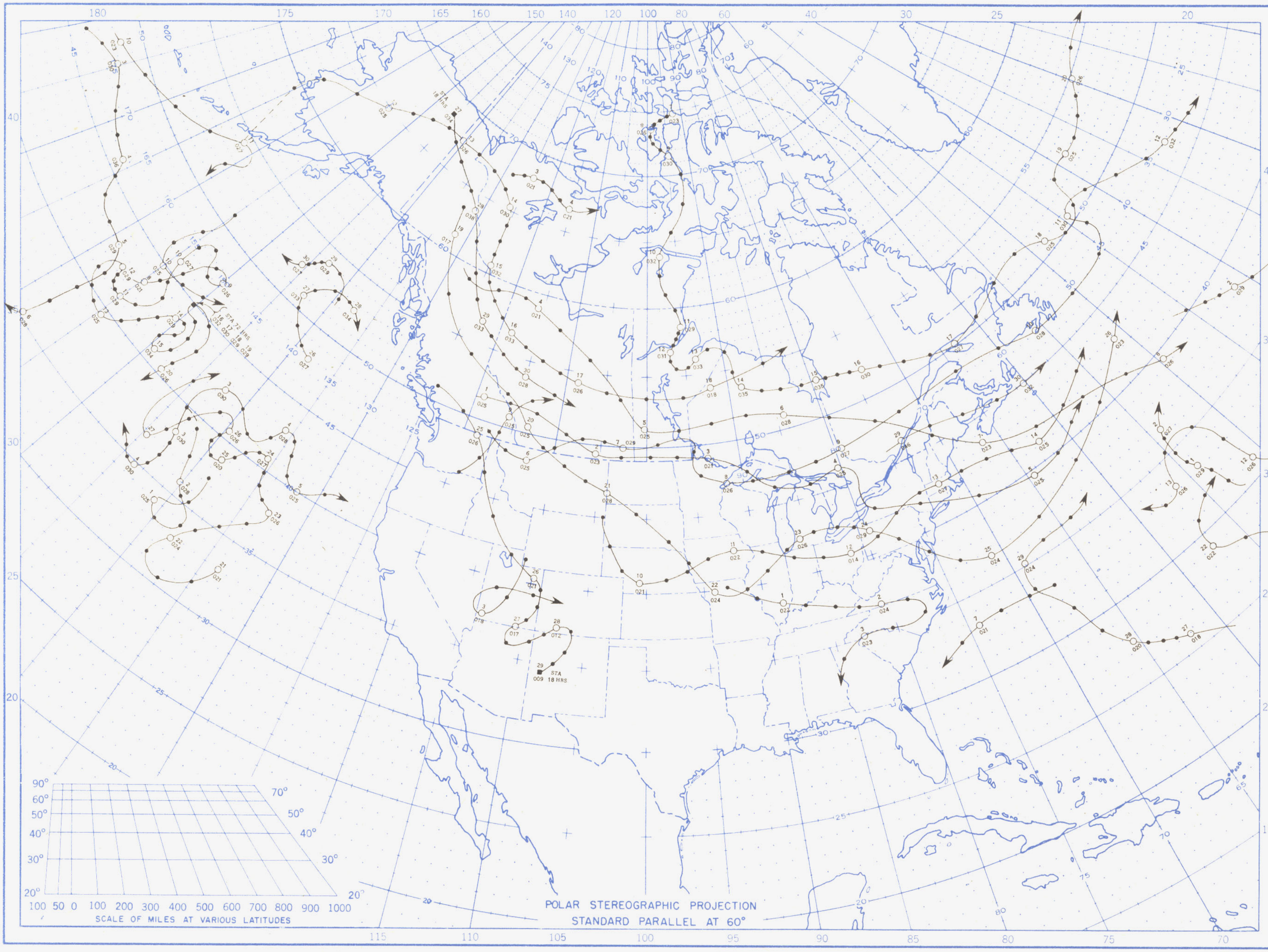


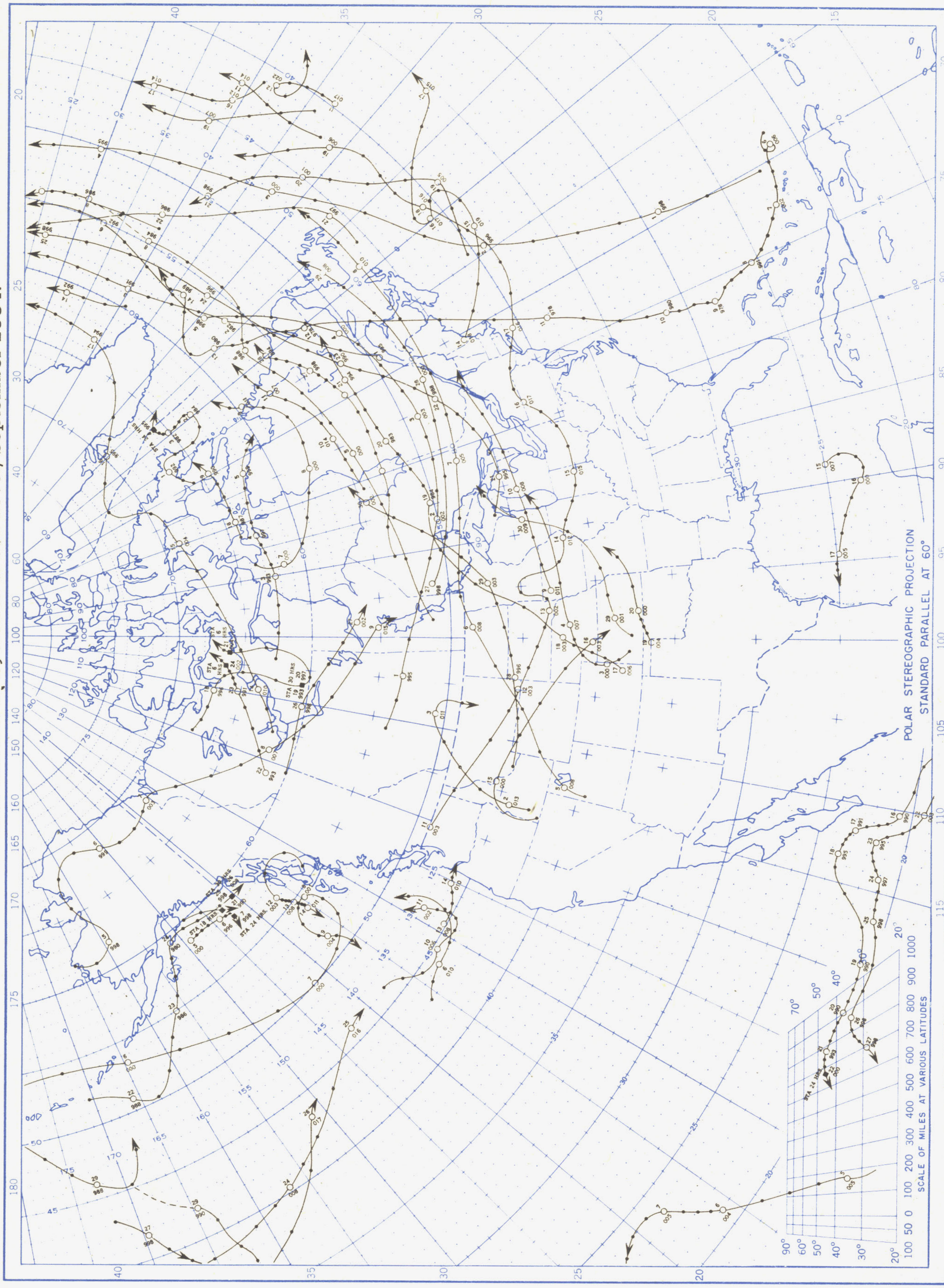
Chart shows mean daily solar radiation, direct + diffuse, received on a horizontal surface in langleys (1 langley = 1 gm. cal. cm.$^{-2}$). Basic data for isolines are shown on chart. Further estimates are obtained from supplementary data for which limits of accuracy are wider than for those data shown. Normals are computed for stations having at least 9 years of record.

Chart IX. Tracks of Centers of Anticyclones at Sea Level, September 1954.



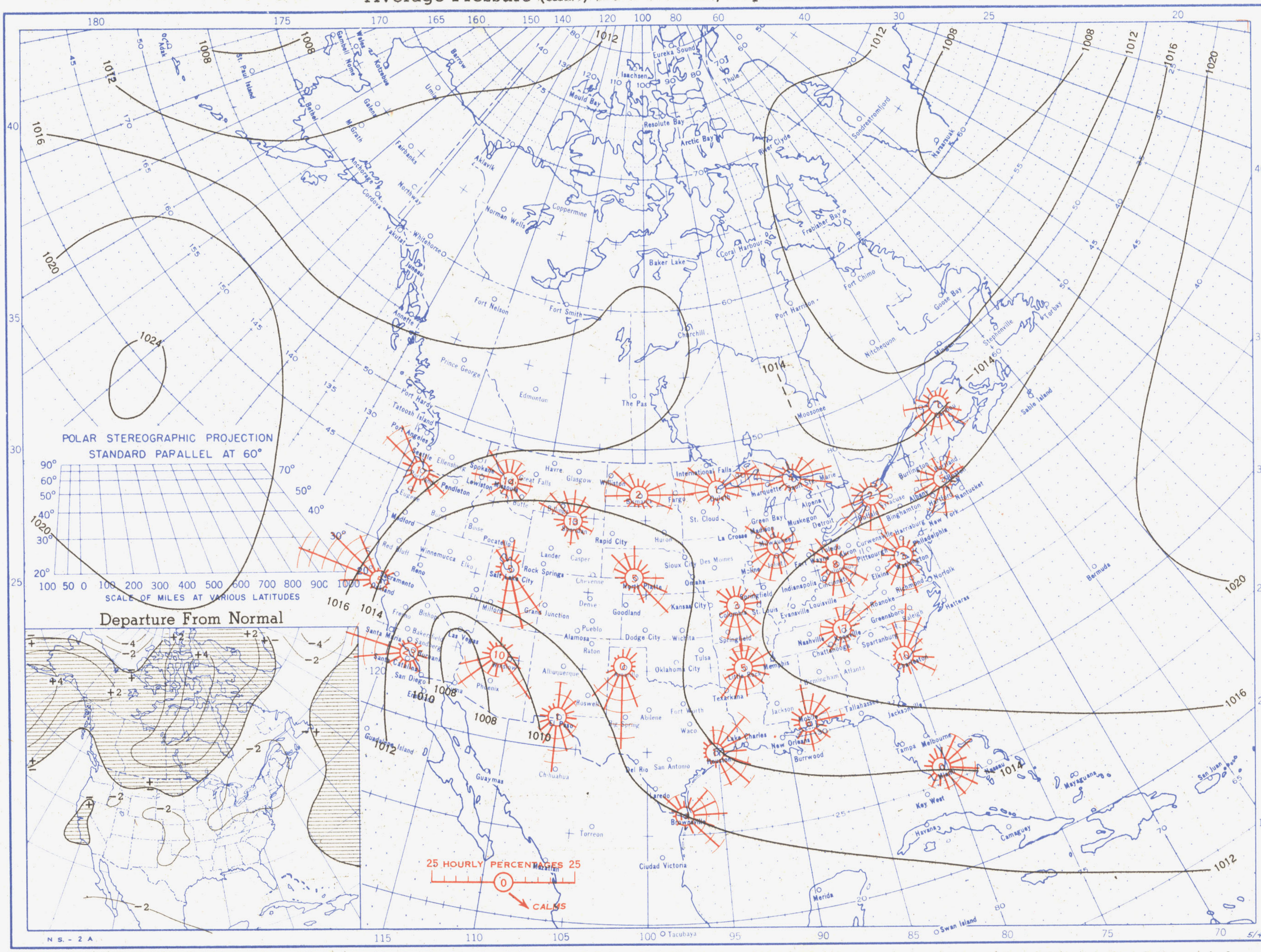
Circle indicates position of center at 7:30 a. m. E. S. T. Figure above circle indicates date, figure below, pressure to nearest millibar. Dots indicate intervening 6-hourly positions. Squares indicate position of stationary center for period shown. Dashed line in track indicates reformation at new position. Only those centers which could be identified for 24 hours or more are included.

Chart X. Tracks of Centers of Cyclones at Sea Level, September 1954.



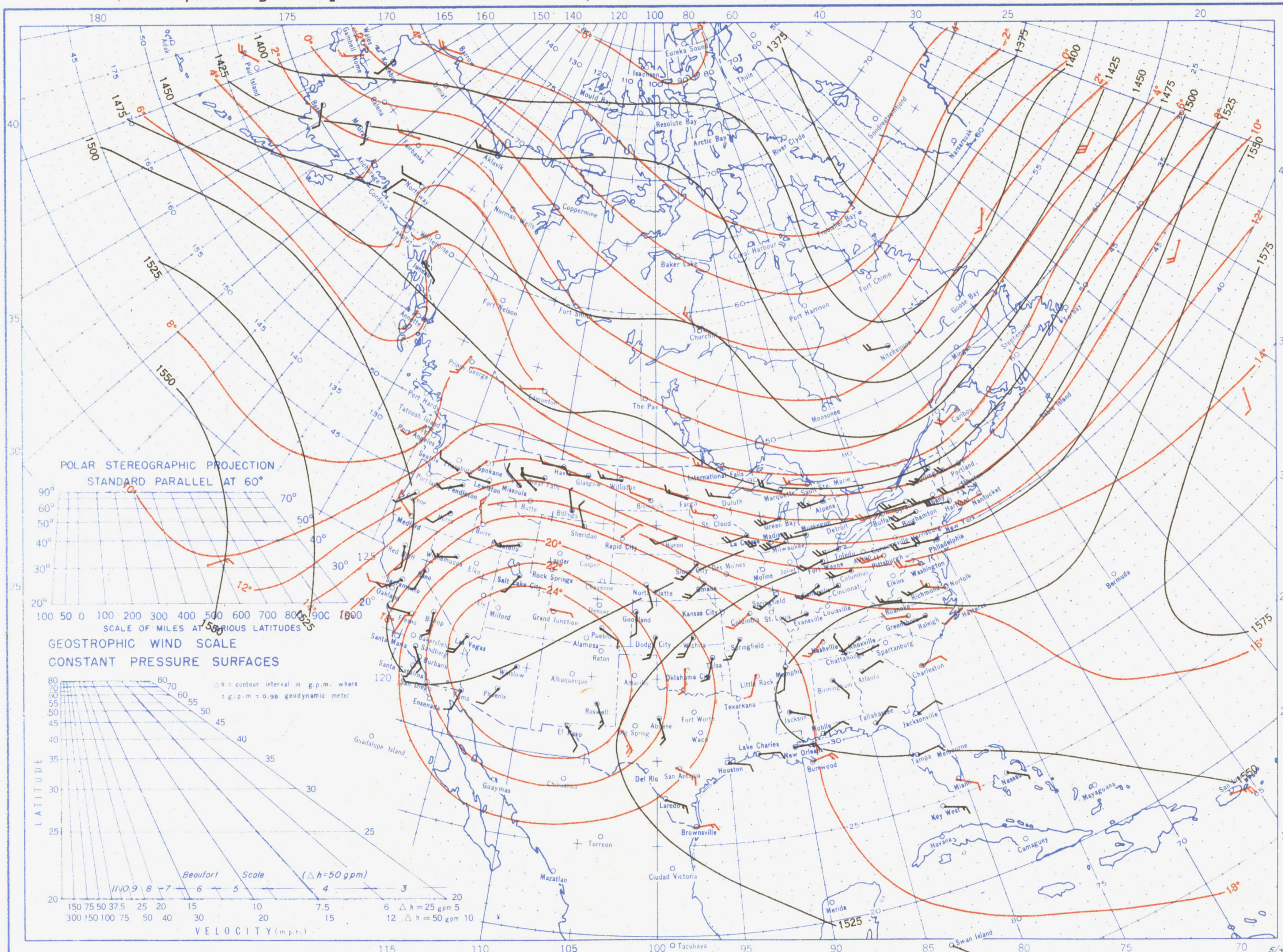
Circle indicates position of center at 7:30 a. m. E. S. T. See Chart IX for explanation of symbols.

Chart XI. Average Sea Level Pressure (mb.) and Surface Windroses, September 1954. Inset: Departure of Average Pressure (mb.) from Normal, September 1954.



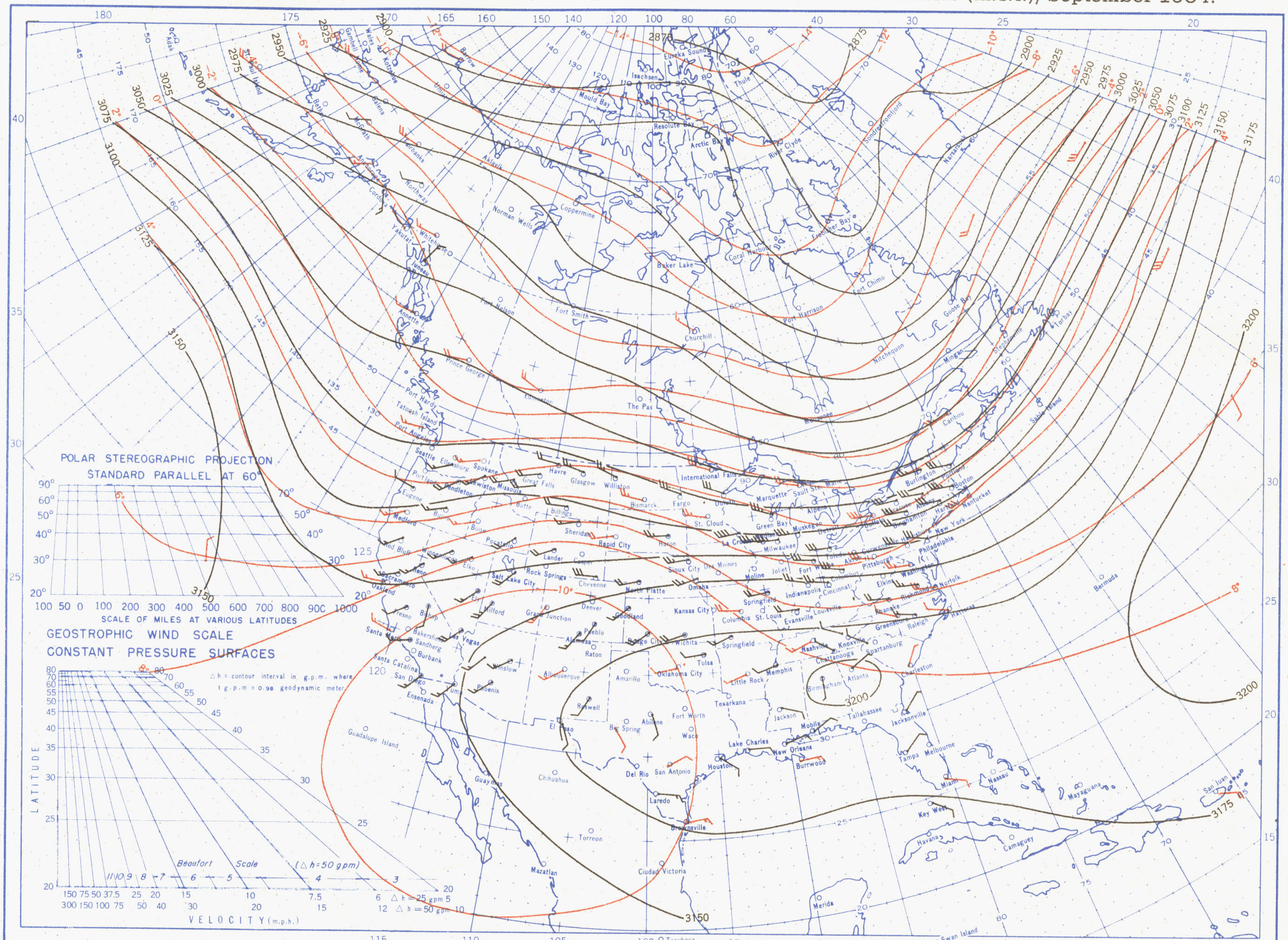
Average sea level pressures are obtained from the averages of the 7:30 a. m. and 7:30 p. m. E. S. T. readings. Windroses show percentage of time wind blew from 16 compass points or was calm during the month. Pressure normals are computed for stations having at least 10 years of record and for 10° intersections in a diamond grid based on readings from the Historical Weather Maps (1899-1939) for the 20 years of most complete data coverage prior to 1940.

Chart XII. Average Dynamic Height in Geopotential Meters (1 g.p.m. = 0.98 dynamic meters) of the 850-mb. Pressure Surface, Average Temperature in °C. at 850 mb., and Resultant Winds at 1500 Meters (m.s.l.), September 1954.



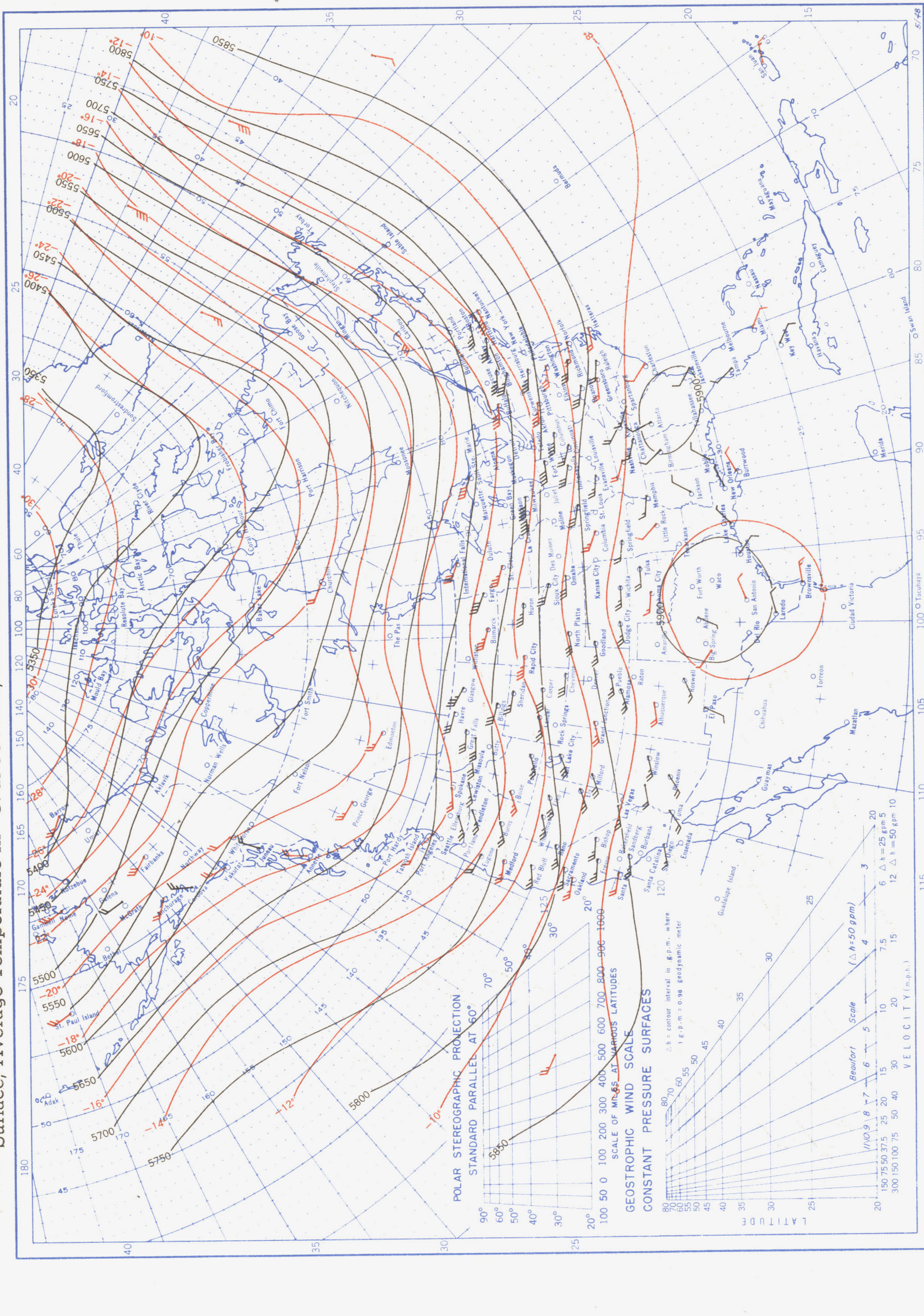
Contour lines and isotherms based on radiosonde observations at 0300 G. M. T. Winds shown in black are based on pilot balloon observations at 2100 G. M. T.; those shown in red are based on rawins taken at 0300 G. M. T. Wind barbs indicate wind speed on the Beaufort scale.

Chart XIII. Average Dynamic Height in Geopotential Meters (1 g.p.m.. = 0.98 dynamic meters) of the 700-mb. Pressure Surface, Average Temperature in °C. at 700 mb., and Resultant Winds at 3000 Meters (m.s.l.), September 1954.



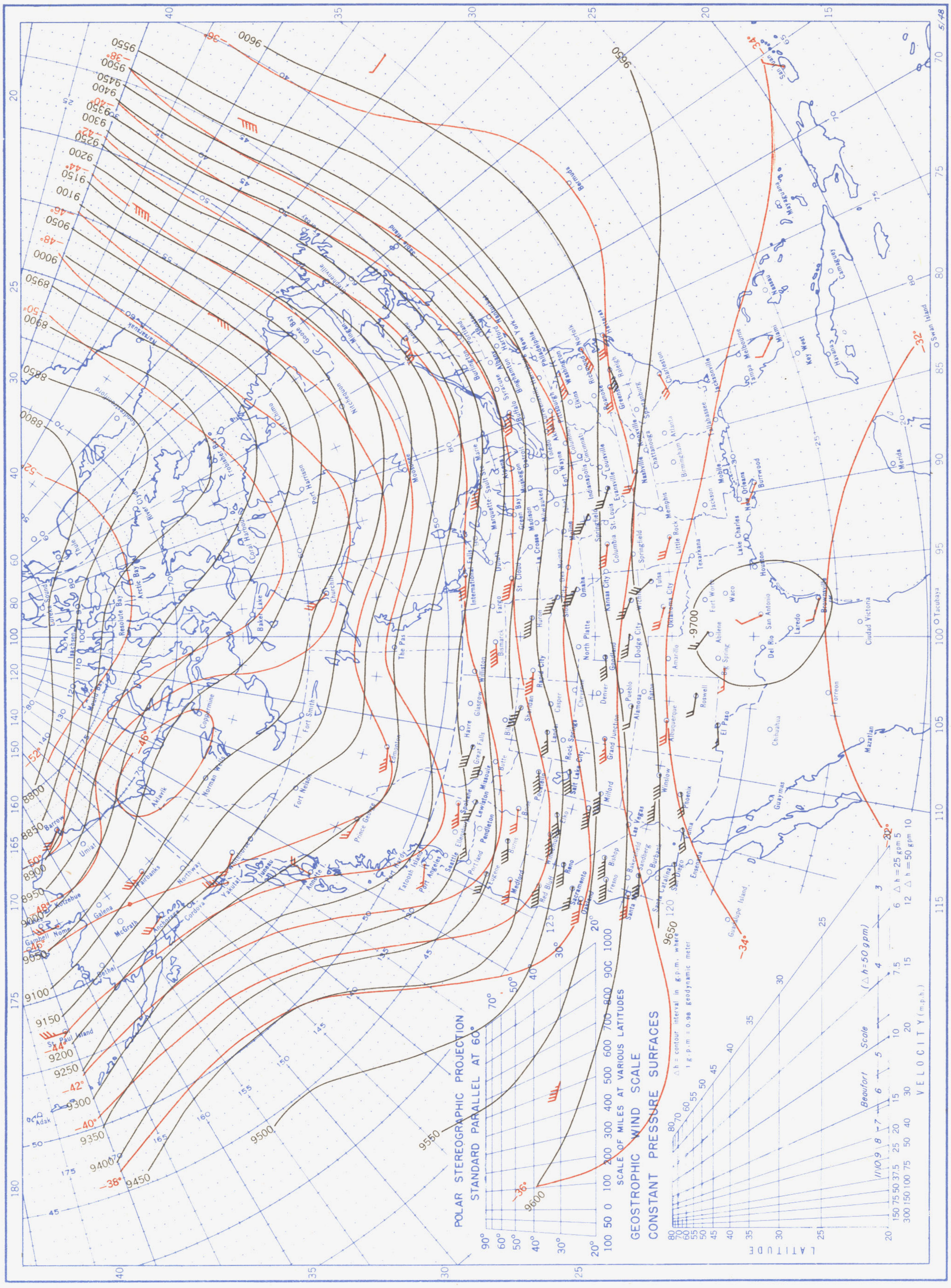
Contour lines and isotherms based on radiosonde observations at 0300 G. M. T. Winds shown in black are based on pilot balloon observations at 2100 G. M. T.; those shown in red are based on rawins taken at 0300 G. M. T. Wind barbs indicate wind speed on the Beaufort scale.

Chart XIV. Average Dynamic Height in Geopotential Meters (1 g.p.m. = 0.98 dynamic meters) of the 500-mb. Pressure Surface, Average Temperature in °C. at 500 mb., and Resultant Winds at 5000 Meters (m.s.l.), September 1954.



Contour lines and isotherms based on radiosonde observations at 0300 G. M. T. Winds shown in black are based on pilot balloon observations at 2100 G. M. T.; those shown in red are based on rawins at 0300 G. M. T. Wind barbs indicate wind speed on the Beaufort scale.

Chart XV. Average Dynamic Height in Geopotential Meters (1 g.p.m. = 0.98 dynamic meters) of the 300-mb. Pressure Surface, Average Temperature in °C. at 300 mb., and Resultant Winds at 10,000 Meters (m.s.l.), September 1954.



Contour lines and isotherms based on radiosonde observations at 0300 G. M. T. Winds shown in black are based on pilot balloon observations at 2100 G. M. T.; those shown in red are based on rawins at 0300 G. M. T. Wind barbs indicate wind speed on the Beaufort scale.